CLAIMS

What is claimed is:

1. A wavelength-dependent, optical-signal detector, comprising:

   a) a semiconductor substrate with a surface;

   b) a comb-like metal electrode deposited in at least one layer located above said surface of said semiconductor substrate, said comb-like metal electrode comprising a plurality of arms at a common voltage;

   c) a voltage means; and

   d) a plurality of metal electrodes deposited in at least one layer located above said surface of said semiconductor substrate and interdigited between said arms of said comb-like metal electrode, said metal electrodes connected to said voltage means to provide each of said metal electrodes with a control voltage, said control voltage provided to each of said metal electrodes chosen to control collection and superposition of charge carriers produced in said wavelength-dependent, optical-signal detector by an optical signal, thereby selecting a wavelength to be detected with said wavelength-dependent, optical-signal detector.

2. The wavelength-dependent, optical-signal detector of claim 1 wherein said comb-like metal electrode and said metal electrodes are substantially coplanar.

3. The wavelength-dependent, optical-signal detector of claim 1 wherein said comb-like metal electrode further comprises at least five arms.

4. The wavelength-dependent, optical-signal detector of claim 1 wherein said metal electrodes further comprise at least four electrodes.

5. The wavelength-dependent, optical-signal detector of claim 1 further comprising at least one opaque masking layer deposited in at least one layer located above said surface of said semiconductor substrate such that a pair of electrodes, comprising one of said arms of said comb-like metal electrode and one of said metal electrodes, is separated from neighboring electrodes by said opaque masking layer.

6. The wavelength-dependent, optical-signal detector of claim 1 where in said semiconductor substrate is selected from the group consisting of GaAs and InP.

7. The wavelength-dependent, optical-signal detector of claim 1 further comprising a base layer, with a surface, deposited at a location above said surface of said semiconductor substrate and below said layer containing said comb-like metal electrode and said layer containing said metal electrodes.

8. The wavelength-dependent, optical-signal detector of claim 7 where in said base layer is selected from the group consisting of GaAs, InGaAs, AlGaAs and InP.

9. The wavelength-dependent, optical-signal detector of claim 7 further comprising an intermediate layer, with a surface, deposited at a location above said surface of said base layer and below said layer containing

said comb-like metal electrode and said layer containing said metal electrodes.

10. The wavelength-dependent, optical-signal detector of claim 9 where in said intermediate layer is selected from the group consisting of InAlAs, GaAs, AlGaAs and InGaAs.

11. The wavelength-dependent, optical-signal detector of claim 9 further comprising a top layer deposited at a location above said surface of said intermediate layer and below said layer containing said comb-like metal electrode and said layer containing said metal electrodes.

12. The wavelength-dependent, optical-signal detector of claim 11 where in said top layer is selected from the group consisting of GaAs and InAlAs.

13. The wavelength-dependent, optical-signal detector of claim 1 wherein said voltage means comprises separate voltage sources for providing a separate control voltage to each of said metal electrodes.

14. The wavelength-dependent, optical-signal detector of claim 1 wherein said comb-like metal electrode is connected to an amplifier for amplifying.

15. The wavelength-dependent, optical-signal detector of claim 14 wherein said amplifier is a trans-impedance amplifier.

16. The wavelength-dependent, optical-signal detector of claim 1 wherein production of said charge carriers in response to said optical signal in regions in said wavelength-dependent, optical-signal detector is enabled and production of said charge carriers in response to said optical signal in other regions in said wavelength-dependent, optical-signal detector is disabled.

17. The wavelength-dependent, optical-signal detector of claim 16 wherein a standing wave pattern obtained from said optical signal enables and disables production of charge carriers in response to said optical signal in said regions and said other regions in said wavelength-dependent, optical-signal detector.

18. The wavelength-dependent, optical-signal detector of claim 17 wherein an interferometer produces said standing wave pattern.

19. The wavelength-dependent, optical-signal detector of claim 17 wherein said standing wave pattern is positioned relative to said metal electrodes and said comb-like metal electrode to enable detection of said wavelength in said wavelength-dependent, optical-signal detector.

20. An optical system, comprising:

a) a stream of light with a plurality of wavelengths containing information; and

b) at least one wavelength-dependent detector having a set of electrodes for switching between wavelengths, wherein charge carriers produced by said stream of light in said wavelength-dependent detector are collected and superposed in response to a set of control voltages applied to said set of

electrodes in said wavelength-dependent detector by a voltage means, wherein a wavelength to be detected predetermines said set of control voltages applied to said set of electrodes.

21. The optical system of claim 20 wherein RC time constant of said wavelength-dependent detector provides for switching between wavelengths in less than 10 ns.

22. The optical system of claim 20 further comprising at least one amplifier.

23. The optical system of claim 22 wherein said amplifier is a trans-impedance amplifier.

24. The optical system of claim 20 further comprising at least one dispersion device for spatially segregating said light stream.

25. The optical system of claim 24 wherein said dispersion device is selected from the group consisting of a diffraction grating, a prism and an array waveguide grating.

26. The optical system of claim 20 further comprising a plurality of wavelength-dependent detectors, each of which is used to detect a range of wavelengths.

27. The optical system of claim 20 further comprising at least one lens to focus said stream of light onto said wavelength-dependent detector.

28. The optical system of claim 20 further comprising at least one standing-wave generator for generating a wavelength-dependent, spatially varying light intensity.

29. The optical system of claim 28 wherein angle of incidence of at least two beams in said stream of light to said wavelength-dependent detector determines position and period of said spatially varying light intensity relative to said set of electrodes in said wavelength-dependent detector.

30. The optical system of claim 28 wherein said standing-wave generator is an interferometer.

31. The optical system of claim 30 wherein optical path length difference in said interferometer determines position of said spatially varying light intensity relative to said set of electrodes in said wavelength-dependent detector.

32. The optical system of claim 30 wherein channel spacing is determined by path length difference in said interferometer.

33. The optical system of claim 20 wherein information in said stream of light is encoded with a technique selected from the group consisting of time domain multiplexing, frequency domain multiplexing, time domain and frequency domain multiplexing, spread-spectrum encoding and iterative coding.

34. The optical system of claim 33 wherein spread-spectrum encoding is code division multiple access.

35. The optical system of claim 20 wherein said optical system is at least part of a system selected from the group consisting of DWDM, CWDM, WDM, a spectrometer, an optical interconnect and an optical sensor.

36. The optical system of claim 20 wherein said wavelength-dependent detector comprises:

a) a semiconductor substrate with a surface;

b) a comb-like metal electrode deposited in a layer located above said surface of said semiconductor substrate, said comb-like metal electrode comprising at least five arms at a common voltage;

c) a voltage means;

d) at least four metal electrodes deposited in a layer located above said surface of said semiconductor substrate, substantially coplanar with said comb-like metal electrode and interdigited between said arms of said comb-like metal electrode, each of said metal electrodes connected to said voltage means which provides said set of control voltages to said metal electrodes; and

e) a trans-impedance amplifier connected to said comb-like metal electrode.

37. The optical system of claim 36 further comprising at least one opaque masking layer deposited in a layer located above said surface of said semiconductor substrate such that a pair of electrodes, comprising one of said arms of said comb-like metal electrode and one of said metal

electrodes, is separated from neighboring electrodes by said opaque masking layer.

38. The optical system of claim 36 wherein said voltage means comprises separate voltage sources for providing a separate control voltage in said set of control voltages to each of said metal electrodes.

39. The optical system of claim 38 wherein said semiconductor substrate is taken from the group consisting of GaAs and InP.

40. The optical system of claim 36 further comprising a base layer, with a surface, deposited at a location above said surface of said semiconductor substrate and below said layer containing said comb-like metal electrode and said layer containing said metal electrodes.

41. The optical system of claim 40 where in said base layer is taken from the group consisting of GaAs, InGaAs, AlGaAs and InP.

42. The optical system of claim 40 further comprising an intermediate layer, with a surface, deposited at a location above said surface of said base layer and below said layer containing said comb-like metal electrode and said layer containing said metal electrodes.

43. The optical system of claim 42 where in said intermediate layer is taken from the group consisting of InAlAs, GaAs, AlGaAs and InGaAs.

44. The wavelength-dependent, optical-signal detector of claim 42 further comprising a top layer deposited at a location above said surface of said intermediate layer and below said layer containing said comb-like metal electrode and said layer containing said metal electrodes.

45. The wavelength-dependent, optical-signal detector of claim 44 where in said top layer is selected from the group consisting of GaAs and InAlAs.

46. A method of detecting a wavelength of light with a wavelength-dependent detector, comprising:

a) illuminating said wavelength-dependent detector with said light containing said wavelength;

b) connecting said wavelength-dependent detector to a voltage means; and

c) setting a control voltage on each of a plurality of metal electrodes interdigitated with a plurality of arms in a comb-like metal electrode in said wavelength-dependent detector with said voltage means, said control voltage set on each of said metal electrodes controlling collection and superposition of charge carriers produced in said wavelength-dependent detector by said light, thereby selecting said wavelength.

47. The method of claim 46 further comprising the step of connecting said comb-like metal electrode in said wavelength-dependent detector to an amplifier.

48. The method of claim 46 further comprising the step of selecting said wavelength of said light by spatially segregating said light with a dispersion device.

49. The method of claim 46 further comprising the step of producing a spatially varying intensity of said light on said wavelength-dependent detector by passing said light through an interferometer.

50. The method of claim 49 further comprising the step of setting position of said spatially varying light intensity relative to said metal electrodes in said wavelength-dependent detector by adjusting angle of incidence of at least two beams in said light to said wavelength-dependent detector.

51. The method of claim 49 further comprising the step of setting position and period of said spatially varying light intensity relative to said metal electrodes in said wavelength-dependent detector by adjusting optical path length difference in said interferometer.

52. The method of claim 49 further comprising the step of adjusting channel spacing by changing path length difference in said interferometer.